# Supplementary Materials

Datasets

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## Contents

## 1 Data

We provide experiment data here. In the slide, some part of the tables were skipped due to its size.

### 1.1 Experiment Data

The following is the raw dataset:

```
ecg
#> # A tibble: 16 x 7
#>       id date       water speed coffee   pre  post
#>    <dbl> <date>     <dbl> <dbl>  <dbl> <dbl> <dbl>
#>  1     1 2021-04-22     1     1      1    80    89
#>  2     2 2021-04-23     1     2      4    77    78
#>  3     3 2021-04-24     1     3      2    76    83
#>  4     4 2021-04-25     1     4      3    76    79
#>  5     5 2021-04-26     2     1      4    75    77
#>  6     6 2021-04-27     2     2      2    77    83
#>  7     7 2021-04-28     2     3      3    90    93
#>  8     8 2021-04-29     2     4      1    81    95
#>  9     9 2021-04-30     3     1      2    83    87
#> 10    10 2021-05-01     3     2      3    74    77
#> 11    11 2021-05-02     3     3      1    77    78
#> 12    12 2021-05-03     3     4      4    74    74
#> 13    13 2021-05-04     4     1      3    75    77
#> 14    14 2021-05-05     4     2      1    88    92
#> 15    15 2021-05-06     4     3      4    69    71
#> 16    16 2021-05-07     4     4      2    72    76
```

Table 1 is LSD format based on $y_{rc} := y_{rc}^{post} - y_{rc}^{pre}$.

Table 1: Experiment Data

| water | \<=5 | 5-15 | 15-30 | 30\< |
|---|---|---|---|---|
| | \<=5 | 5-15 | 15-30 | 30\< |
| 0 ml | HB, 9 | W, 1 | S, 7 | D, 3 |
| 100 ml | W, 2 | S, 6 | D, 3 | HB, 14 |
| 200 ml | S, 4 | D, 3 | HB, 1 | W, 0 |
| 300 ml | D, 2 | HB, 4 | W, 2 | S, 4 |

The header spans "Drinking Speed" over the four speed columns.

[1] Caffeine: HB > S > D > W

[2] Numbers indicate the difference after and before taking coffee

## 1.2 Science Table

To test sharp null of no effect

$$H_0 : y_{rc}(1) = y_{rc}(2) = y_{rc}(3) = y_{rc}(4) \tag{1}$$

we build the science table in Table 2.

Table 2: Observed Values of the Science Table

| id | water | speed | coffee | HB | W | S | De |
|---|---|---|---|---|---|---|---|
| **Row 1 (Water 0 ml)** | | | | | | | |
| 1 | 1 | 1 | 1 | 9 | | | |
| 2 | 1 | 2 | 4 | | 1 | | |
| 3 | 1 | 3 | 2 | | | 7 | |
| 4 | 1 | 4 | 3 | | | | 3 |
| **Row 2 (Water 100 ml)** | | | | | | | |
| 5 | 2 | 1 | 4 | | 2 | | |
| 6 | 2 | 2 | 2 | | | 6 | |
| 7 | 2 | 3 | 3 | | | | 3 |
| 8 | 2 | 4 | 1 | 14 | | | |
| **Row 3 (Water 200 ml)** | | | | | | | |
| 9 | 3 | 1 | 2 | | | 4 | |
| 10 | 3 | 2 | 3 | | | | 3 |
| 11 | 3 | 3 | 1 | 1 | | | |
| 12 | 3 | 4 | 4 | | 0 | | |
| **Row 4 (Water 300 ml)** | | | | | | | |
| 13 | 4 | 1 | 3 | | | | 2 |
| 14 | 4 | 2 | 1 | 4 | | | |
| 15 | 4 | 3 | 4 | | 2 | | |
| 16 | 4 | 4 | 2 | | | 4 | |

The "Observed $y_{rc}(k)$" header spans the HB, W, S, De columns.

Now we impute impute the missing $Y_{rc}(k)$ under the sharp null. See Table 3.

Table 3: Imputed Outcomes under the Sharp Null

| id | water | speed | coffee | HB | W | S | De |
|---|---|---|---|---|---|---|---|
| **Row 1 (Water 0 ml)** | | | | | | | |
| 1 | 1 | 1 | 1 | 9 | 9 | 9 | 9 |

The "Observed $y_{rc}(k)$" header spans the HB, W, S, De columns.

2

| 2 | 1 | 2 | 4 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|---|---|---|
| 3 | 1 | 3 | 2 | 7 | 7 | 7 | 7 |
| 4 | 1 | 4 | 3 | 3 | 3 | 3 | 3 |
| **Row 2 (Water 100 ml)** | | | | | | | |
| 5 | 2 | 1 | 4 | 2 | 2 | 2 | 2 |
| 6 | 2 | 2 | 2 | 6 | 6 | 6 | 6 |
| 7 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| 8 | 2 | 4 | 1 | 14 | 14 | 14 | 14 |
| **Row 3 (Water 200 ml)** | | | | | | | |
| 9 | 3 | 1 | 2 | 4 | 4 | 4 | 4 |
| 10 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| 11 | 3 | 3 | 1 | 1 | 1 | 1 | 1 |
| 12 | 3 | 4 | 4 | 0 | 0 | 0 | 0 |
| **Row 4 (Water 300 ml)** | | | | | | | |
| 13 | 4 | 1 | 3 | 2 | 2 | 2 | 2 |
| 14 | 4 | 2 | 1 | 4 | 4 | 4 | 4 |
| 15 | 4 | 3 | 4 | 2 | 2 | 2 | 2 |
| 16 | 4 | 4 | 2 | 4 | 4 | 4 | 4 |

## 1.3 After Presentation

In general, heart rate variable is used as log scale, i.e. here, log-return.

See Table 4.

Table 4: Experiment Data - log-return for the average heart rate

| water | <=5 | 5-15 | 15-30 | 30< |
|---|---|---|---|---|
| | | Drinking Speed | | |
| 0 ml | HB, 0.107 | W, 0.013 | S, 0.088 | D, 0.039 |
| 100 ml | W, 0.026 | S, 0.075 | D, 0.033 | HB, 0.159 |
| 200 ml | S, 0.047 | D, 0.04 | HB, 0.013 | W, 0 |
| 300 ml | D, 0.026 | HB, 0.044 | W, 0.029 | S, 0.054 |

[1] Caffeine: HB > S > D > W

[2] Numbers indicate the difference after and before taking coffee

Table 5 is the imputed science table.

Table 5: Imputed Outcomes under the Sharp Null - log-return

| id | water | speed | coffee | HB | W | S | De |
|---|---|---|---|---|---|---|---|
| | | | | | Observed $y_{rc}(k)$ | | |
| **Row 1 (Water 0 ml)** | | | | | | | |
| 1 | 1 | 1 | 1 | 0.107 | 0.107 | 0.107 | 0.107 |
| 2 | 1 | 2 | 4 | 0.013 | 0.013 | 0.013 | 0.013 |
| 3 | 1 | 3 | 2 | 0.088 | 0.088 | 0.088 | 0.088 |
| 4 | 1 | 4 | 3 | 0.039 | 0.039 | 0.039 | 0.039 |
| **Row 2 (Water 100 ml)** | | | | | | | |
| 5 | 2 | 1 | 4 | 0.026 | 0.026 | 0.026 | 0.026 |
| 6 | 2 | 2 | 2 | 0.075 | 0.075 | 0.075 | 0.075 |
| 7 | 2 | 3 | 3 | 0.033 | 0.033 | 0.033 | 0.033 |
| 8 | 2 | 4 | 1 | 0.159 | 0.159 | 0.159 | 0.159 |
| **Row 3 (Water 200 ml)** | | | | | | | |
| 9 | 3 | 1 | 2 | 0.047 | 0.047 | 0.047 | 0.047 |
| 10 | 3 | 2 | 3 | 0.040 | 0.040 | 0.040 | 0.040 |
| 11 | 3 | 3 | 1 | 0.013 | 0.013 | 0.013 | 0.013 |
| 12 | 3 | 4 | 4 | 0.000 | 0.000 | 0.000 | 0.000 |
| **Row 4 (Water 300 ml)** | | | | | | | |
| 13 | 4 | 1 | 3 | 0.026 | 0.026 | 0.026 | 0.026 |
| 14 | 4 | 2 | 1 | 0.044 | 0.044 | 0.044 | 0.044 |
| 15 | 4 | 3 | 4 | 0.029 | 0.029 | 0.029 | 0.029 |
| 16 | 4 | 4 | 2 | 0.054 | 0.054 | 0.054 | 0.054 |

# 2 ECG Results

From ECG app, we get the graph as in Figure 1.



(a) (1,1),House blend: 89 BPM

(b) (1,2),Water: 78 BPM

(c) (1,3),Sumatra: 83 BPM

(d) (1,4),Decaf: 79 BPM

(e) (2,1),Water: 77 BPM

(f) (2,2),Sumatra: 83 BPM

(g) (2,3),Decaf: 93 BPM

(h) (2,4),House blend: 95 BPM

(i) (3,1),Sumatra: 87 BPM

(j) (3,2),Decaf: 77 BPM

(k) (3,3),House blend: 78 BPM

(l) (3,4),Water: 74 BPM

(m) (4,1),Decaf: 77 BPM

(n) (4,2),House blend: 92 BPM

(o) (4,3),Water: 71 BPM

(p) (4,4),Sumatra: 76 BPM

Figure 1: Electrocardiogram after drinking Coffee